WHAT IS CLAIMED:

1. A method of operating a mass spectrometer comprising an ion source, an ion trap with a plurality of elongate electrodes, a collision cell and a time of flight analyzer, the method comprising:

trapping ions introduced from the ion source, and exciting the trapped ions so as to eject the said trapped ions substantially orthogonally with respect to the direction of elongation of the electrodes, such that the ejected ions travel to the collision cell;

fragmenting ions introduced from the ion trap in the collision cell;

ejecting fragmented ions from the collision cell such that they travel to the time of flight mass analyzer; and

operating the time of flight mass analyzer to obtain a mass spectrum of ions therein.

2. The method of claim 1, wherein exciting the ions trapped in the ion trap comprises applying an AC potential to the plurality of elongate electrodes.

3. The method of claim 1, wherein the trapped ions are ejected as a ribbon beam and the collision cell is of a planar design.

4. The method of claim 1, comprising operating the collision cell to trap ions.

5. The method of claim 4, wherein the ions are trapped using a field including a DC potential.

6. The method of claim 1, comprising operating the collision cell using DC potentials only.

7. The method of claim 1, comprising operating the collision cell to provide an electric field along an ion path therethrough, the gradient of the electric field increasing monotonously along the ion path.

8. The method of claim 1, comprising introducing ions into the collision cell in a direction orthogonal to their direction of exiting the collision cell.

9. The method of claim 1, wherein the collision cell comprises a plurality of elongate, composite rod electrodes having at least two parts, the method comprising applying an RF potential to both parts of each rod and applying a different DC potential to each part of each rod.

10. The method of claim 9, further comprising applying a DC potential to a pair of electrodes that sandwich the composite rods.

11. The method of claim 1, comprising operating an ion detector located in or adjacent the ion trap to obtain a mass spectrum of the trapped ions.

12. The method of claim 11, wherein the ion detector is positioned adjacent the ion trap thereby to intercept a portion of the ions being ejected substantially orthogonally.

13. The method of claim 12, wherein the ion detector and the collision cell are positioned on opposing sides of the ion trap.

14. The method of claim 1, comprising operating the ion detector to obtain a mass spectrum of precursor ions trapped in the ion trap and operating the time of flight mass analyzer to obtain a mass spectrum of the fragmented ions, wherein the scans form a MS/MS experiment.

15. The method of claim 1, comprising: introducing ions generated by an ion source having a relatively broad range of m/z values into the ion trap; trapping ions across substantially all the relatively broad range introduced from the ion source and ejecting ions within a relatively narrow range of m/z values substantially orthogonally.

16. The method of claim 1, comprising filling the ion trap within an ion abundance determined using automatic gain control.

17. The method of claim 1, comprising injecting ions of a reference compound into the collision cell.

18. The method of claim 15, wherein the ion trap is a composite ion trap comprising first and second trapping regions arranged substantially co-axially along a common axis defining an ion path through the first trapping region and into the second trapping region, the method comprising:

introducing ions generated by an ion source having the relatively broad range of m/z values into the first trapping region along the ion path;

operating the first trapping region to trap ions across substantially all the relatively broad range introduced from the ion source and to eject ions within an intermediate range of m/z values axially thereby to travel to the second trapping region along the ion path; and

operating the second trapping region to trap ions introduced from the first trapping region and to eject ions within the relatively narrow range of m/z values orthogonally.

19. The method of claim 18, wherein the first and second trapping regions are separated by a first potential barrier and the method comprises ejecting ions from the first trapping region by exciting ions within the intermediate range of m/z values to an energy sufficient to overcome the first potential barrier and thereby travel to the second trapping region.

20. The method of claim 19, wherein ions are introduced into the first trapping region thorough an entrance at a first end of the first trapping region and the ions exit the first trapping region through an exit at a second end of the first trapping region, the first potential barrier being located at the exit, the method further comprising: setting the first potential barrier to reflect ions introduced into the first trapping region; subsequently creating a second, higher potential at the entrance thereby trapping ions within the first trapping region; and exciting ions within the intermediate range of m/z values sufficient to overcome the first potential barrier but not to overcome the second potential barrier.

21. The method of claim 20, wherein creating the second potential barrier comprises using a DC potential.

22. The method of claim 18, wherein setting the first potential barrier to reflect ions introduced into the first trapping region comprises using a DC potential.

23. The method of claim 18, wherein exciting ions within the intermediate range of m/z values comprises adding an AC potential to the first potential barrier.

24. The method of claim 23, comprising exciting ions trapped in the second trapping region using an AC potential.

25. The method of claim 18, comprising introducing ions into the second trapping region to fill the second trapping region to a predetermined ion abundance within a space-charge limit.

26. The method of claim 25, comprising determining the predetermined ion abundance in accordance with automatic gain control.

27. The method of claim 1, comprising operating the ion source to generate ions having a relatively broad range of m/z values, and operating the ion trap to eject ions within a relatively narrow range of m/z values substantially orthogonally.

28. The method of claim 27, comprising ejecting ions within a relatively narrow range of m/z values substantially orthogonally from the ion trap whilst retaining other ions in the ion trap for subsequent analysis and/or fragmentation.

29. The method of claim 28, further comprising a second step of analysis including operating the ion trap to eject at least some of said other ions having m/z values within a

further relatively narrow range such that they are introduced into the collision cell and operating the collision cell such that ions so introduced from the ion trap are fragmented.

30. The method of claim 29, further comprising introducing fragmented ions from the second step of analysis into the time of flight mass analyzer and operating the time of flight mass analyzer to obtain a mass spectrum of the fragmented ions.

31. The method of claim 30, comprising third or more successive steps of analysis and obtaining a mass spectrum of the fragmented ions using the time of flight mass analyzer.

32. The method of claim 30, wherein the steps of analysis comprise ejecting ions with relatively narrow ranges of m/z values that combine to span substantially all the intermediate range.

33. The method of claim 28, comprising retaining substantially all ions not within the relatively narrow range of m/z values in the ion trap when ejecting ions within the relatively narrow range.

34. A method of tandem mass spectrometry using a mass spectrometer comprising an ion source, a first trapping region, a second trapping region comprising a plurality of elongate electrodes, a collision cell, an ion detector and a time of flight mass analyzer, the method comprising:

a filling stage comprising

operating the ion source to generate ions,

introducing ions generated by the ion source into the first trapping region, and

operating the first trapping region to trap a primary set of precursor ions introduced from the ion source, the primary set of precursor ions having a relatively large range of m/z values;

a first selection/analysis stage comprising

operating the first trapping region to eject a first secondary subset of the primary set of precursor ions, the first secondary set of precursor ions having an intermediate range of m/z values, thereby to travel to the second trapping region while retaining other ions from the primary set of precursor ions in the first trapping region,

operating the second trapping region to trap ions from the first secondary subset of precursor ions introduced from the first trapping region,

operating the ion detector to obtain a mass spectrum of trapped ions from the first secondary subset of precursor ions, and

performing a plurality of fragmentation/analysis stages of trapped ions from the first secondary subset of precursor ions;

a second selection/analysis stage comprising

operating the first trapping region to eject a second secondary subset of the primary set of the precursor ions, the second secondary subset of precursor ions having a different intermediate range of m/z values, thereby to travel to the second trapping region,

operating the second trapping region to trap ions from the second secondary subset of precursor ions introduced from the first trapping region,

operating the ion detector to obtain a mass spectrum of trapped ions from the second secondary subset of precursor ions, and

performing a plurality of fragmentation/analysis stages of trapped ions from the second secondary subset of precursor ions;

wherein each of the respective plurality of fragmentation/analysis stages comprises

operating the second trapping region to eject a tertiary subset of precursor ions with a relatively narrow range of m/z values substantially orthogonally with respect to the direction of elongation of the electrodes such that they are introduced into the collision cell,

operating the collision cell such that ions from the tertiary subset of precursor ions ejected from the second trapping region are fragmented,

introducing fragmented ions from the collision cell into the time of flight mass analyzer, and

operating the time of flight mass analyzer to obtain a mass spectrum of the fragmented ions,

wherein the tertiary subsets of precursor ions for each of the secondary subsets have different relatively narrow ranges of m/z values.

35. The method of claim 34, comprising ejecting tertiary subsets of precursor ions as pulses with temporal widths not exceeding 10 ms.

36. The method of claim 34, wherein the relatively narrow ranges of m/z values span the intermediate range.

37. The method of claim 36, comprising determining the width of the relatively narrow ranges by reference to a preliminary mass spectrum.

38. The method of claim 34, wherein operation of the second trapping region, collision cell and time of flight mass analyzer is tailored according to the tertiary subsets of precursor ions and its fragmented ions.

39. A tandem mass spectrometer comprising an ion source, an ion trap, a collision cell and a time of flight analyzer, wherein:

the ion trap comprises plurality of elongate electrodes operable to provide a trapping field to trap ions introduced from the ion source and to excite trapped ions such that the excited ions are ejected from the ion trap substantially orthogonally to the direction of elongation of the electrodes;

the collision cell is operable to accept ions ejected from the ion trap substantially orthogonally and to fragment accepted ions; and

the time of flight mass analyzer is operable to acquire a mass spectrum of the fragmented ions.

40. The tandem mass spectrometer of claim 39, further comprising an ion detector located adjacent to the ion trap and operative to detect ions ejected substantially orthogonally therefrom.

41. The tandem mass spectrometer of claim 40, wherein the ion detector and the time of flight mass analyzer are positioned on opposing sides of the ion trap.

42. The tandem mass spectrometer of claim 39, wherein the collision cell is of a planar design.

43. The tandem mass spectrometer of claim 39, wherein the time of flight mass analyzer is of the orthogonal acceleration type.

44. The tandem mass spectrometer of claim 43, wherein the time of flight mass analyzer is gridless.

45. A composite ion trap comprising first and second ion storage volumes being arranged substantially co-axially, the common axis defining an ion path through the first ion storage volume and into the second ion storage volume,

the first ion storage volume being defined by an entrance electrode at one end and by a common electrode at the other end, the entrance electrode and the common electrode being operable to provide a trapping field for trapping ions within a first relatively broad range of m/z values in the first ion storage volume, the first ion storage volume further comprising one or more electrodes operable to excite trapped ions within an intermediate m/z range such that the excited ions are ejected axially along the ion path into the second ion storage volume,

the second ion storage volume being defined by the common electrode at one end and a further electrode at the other end, the common electrode and the further electrode being operable to provide a trapping field for trapping ions in the second ion storage volume, the second ion storage volume further comprising a plurality of elongate electrodes operable to excite trapped ions within a relatively narrow m/z range such that the excited

ions are ejected from the second ion storage volume substantially orthogonally to the direction of elongation through an exit aperture.

46. The composite ion trap of claim 45, wherein the exit aperture is elongate in the same direction as the electrodes.

47. A mass spectrometer comprising the composite ion trap of claim 45 and an ion detector located adjacent to the second ion trapping volume and operative to detect ions ejected substantially orthogonally.

48. A tandem mass spectrometer comprising the mass spectrometer of claim 47 and a time of flight mass analyzer positioned to accept ions ejected substantially orthogonally from the second ion storage volume.

49. The tandem mass spectrometer of claim 48, wherein the ion detector and the time of flight mass analyzer are positioned on opposing sides of the second ion storage volume.

50. The tandem mass spectrometer of claim 48, further comprising a collision cell positioned on the ion path between the second ion storage volume and the time of flight analyzer.

51. The tandem mass spectrometer of claim 50, wherein the collision cell is of a planar design.

52. The tandem mass spectrometer of claim 51, wherein the collision cell comprises a plurality of elongate, composite rod electrodes having at least two parts.

53. The tandem mass spectrometer of claim 52, wherein the two parts of the composite rods are connected to separate power supplies.